

THE MEASUREMENT OF INTELLIGENCE BY THE BINET TESTS.

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PART I.

To those who are eugenists in the highest sense the consideration of a scheme of psychological tests is a matter of the first importance. For them such tests have both a theoretical and a practical interest. From a theoretical standpoint, the relations which must subsist between the study of the human mind and the study of the controllable agencies that affect the improvement of the human race have recently been discussed by Mr. McDougall.¹ "It is," he urges, "to the application of experimental methods in the form of mental tests that we must chiefly look for the progress of our knowledge of mental heredity." In a practical sphere, psychological tests have recently acquired an especial value as our only reliable means of diagnosing mental deficiency. By mental deficiency is commonly meant a lack of practical intelligence and scholastic educability due to an abnormality existing virtually from birth. The task of ascertaining what children suffer from such inborn mental defects has, by an Act of Parliament now about to come into force been made compulsory. Upon these grounds, we are faced with an urgent question. What scheme of tests, suited for either theoretical or practical purposes, is now available?

The psychological methods devised for investigating inborn intelligence have commonly been classified into two main groups:² the correlational methods and the age-scale methods, or, as I should prefer to describe them, the methods of internally and of externally graded tests. The former or correlational methods have been elaborated chiefly by English investigators—Sir Francis Galton, Professor Karl Pearson, and Professor Spearman. The age-scale method originated in France, and is generally associated with the name of its author, the late

¹ This *Review*, "Psychology in the Service of Eugenics," Jan., 1914, p. 295 seq.

² cf. William Stern, *Die Psychologischen Methoden der Intelligenz-prüfung*. Leipzig, 1912. This is by far the best review of the entire subject. The relevant chapters in Meumann's *Vorlesungen zur Einführung in die Experimentelle Pädagogik*, Vol. II., 2nd edition, Leipzig, 1913, brings the review of the literature down to a more recent date.

Alfred Binet. Binet's method has of late achieved great popularity. In France, in Belgium, in Switzerland, in Italy, in Russia, and in Sweden, more recently in England and in Scotland, but above all in America, his scheme has been tried and re-tried with almost universal satisfaction. During the last year or two its use has spread very widely among teachers and doctors in this country. Its use has been recommended by the Board of Education; and a brief summary published in its reports.¹ Indeed, both in scientific investigations and in practical diagnosis, the Binet tests threaten to eclipse almost all other methods of measuring intelligence.

In this country, at any rate, no systematic discussion either of its merits or of its limitations has yet appeared. Accordingly, it seems desirable to emphasize the admittedly tentative and restricted nature of the scheme, before its employment becomes prematurely stereotyped and fixed.

At the outset, it is important to remember that there is not one Binet scheme, but several. From 1895 onwards Binet published three or four distinct proposals for testing intelligence, all based upon the same conception, but each differing from the other in important details.² Nor is the latest revision the one that has been most commonly used by other investigators; nor was it considered final by Binet himself. From a letter which I received from M. Binet only a few months before his death it is clear that he was still contemplating the possibility of further improvements.

In consequence of this arrested evolution of the Binet scheme, two facts emerge. First, Binet's own conception of his aim and method continually changed with advancing knowledge. Secondly, since Binet's death, thanks largely to the

¹ cf. *Annual Report for 1912 of the Chief Medical Officer of the Board of Education*, London, 1913, pp. 373-5.

² The chief publications are (1) *L'Etude Expérimentale de l'Intelligence* (Paris, 1903)—summarised in C. S. Myers, *Introduction to Experimental Psychology*, chap. VII., pp. 121-7.

(2) *L'Année Psychologique*, Vol. XI., 1905. "Méthodes nouvelles pour le Diagnostic du Niveau intellectuel des Anormaux," and other articles—summarised in Whipple, *Manual of Mental and Physical Tests*, p. 473 seq.

(3) *L'Année Psychologique*, Vol. XIV., 1908. "Le Développement de l'Intelligence chez les Enfants" (in collaboration with Dr. Simon)—summarised in Whipple, p. 493 seq. (this is the scheme hitherto most commonly employed).

(4) *L'Année Psychologique*, Vol. XVII., 1911. "Nouvelles Recherches sur la Mesure Intellectuel chez les Enfants d'Ecole."

enormous impetus his own writings bestowed, knowledge has advanced still further. In what follows, I shall endeavour to discuss, in the light of Binet's own utterances, and by the aid of subsequent researches both with the age-scale method and with the method of correlation, two broad questions: What do the Binet scales test? How successfully do they test it?

I.

The first half of my paper, then, concerns the object of the Binet scales. What is it they claim to measure? And what is it they really measure?

As to what is precisely that his schemes are intended to measure Binet is never very explicit. Briefly, his aim appears to have been the measurement of native intelligence in terms of its development. Upon analysis, such an aim seems to rest upon three assumptions: (1) that variations in intelligence may be considered as different degrees of one and the same unitary function; (2) that this unitary function underlying intelligence is, in its various degrees, native or inborn; (3) that differences in the amount of native intelligence possessed by different persons can be measured in terms of age, that is, in terms of differences in the degree of development of intelligence possessed by the same persons at different years of their life. Evidence in favour of these questionable propositions Binet contributes only in a very incidental and occasional way. His followers for the most part pass the questions by.

(1) Is intelligence dependent upon a single unitary factor or is it not? The alternatives are clearest if we picture them in crude physiological terms. On the one hand, we may regard the brain as an aggregate of organs, each as independent of the other as the eye is of the ear, or the organ of taste of the organ of smell; on the other hand, we may regard the whole nervous system as consisting of a single tissue throughout, like the blood or the muscular system, tending like them to be equally well or ill developed in all its parts. A scheme of tests devised upon the one hypothesis obviously would cease to be satisfactory if the other proved to be true. Is there, then, such

a thing as general mental ability? Or is intelligence but the net resultant of a number of relatively independent and isolated functions?

To this problem Binet's answer quite rightly was a compromise. Data were not then available for a final or decisive verdict. In *Les Idées modernes sur les Enfants* it appears that he could not commit himself entirely, either, with Professor Spearman, to the hypothesis of a central factor, or, with Professor Thorndike, to the hypothesis of a multiplicity of independent and specific factors. When introducing his first scheme,¹ he briefly indicates the sense he attaches to "that word, so vague, so comprehensive—intelligence." He admits that "almost all the phenomena with which psychology is occupied are phenomena of intelligence—sensation, perception, . . . just as much as reasoning." Yet, we cannot "put the whole of psychology into our tests." What is to be the ground of our selection? "It appears to us that there is in intelligence a fundamental organ, whose absence or alteration is of the greatest importance for practical life: this is, judgment, or in other words, common sense (*le bon sens, le sens pratique*) . . . With Helen Keller, . . . one may be blind, and deaf, and mute, and yet extremely intelligent, "if only one has judgment. If, therefore, tests of sensation or memory are introduced, it is only in order that by their means we may come indirectly to a determination of the capacity of judgment. *Bien juger, bien comprendre, bien raisonner*,—compared with these "the rest of intellectual psychology is of very little importance." Here we have hint of two of the most valuable lessons that psychology owes to Binet's work. First, individual differences, and particularly differences in intelligence, are revealed, not so much in the older instrumental tests of simple sense-perception, movement, or reaction-time, as in tests which approximate to the concrete conditions of everyday life, tests which need no apparatus but "a pen, some paper and a little ink," tests, in short, which involve the higher, more rational, and more complex mental processes. Secondly, there is not, nor ever can be, any one royal test of intelligence. Number and variety are

¹ *L'Année Psychologique*, 1905, pp. 196-7.

essential. Just every organ of the body contains many different kinds of cells, so the "fundamental organ" of intelligence comprises many different kinds of mental activities.¹ Accordingly, "the tests must be heterogeneous, so that we may rapidly embrace a wide field of observation."

The provisional character of this position gives a very provisional character to the selection of the tests. Heterogeneous they are indeed. There are tests of every day knowledge—naming the days of the week, the months of the year, the coins of the realm. There are tests of scholastic attainment—reading, writing, and dictation, on the literary side; counting, addition, and subtraction of money, on the mathematical side; drawing from copy and from memory, upon the manual side. There are more strictly psychological tests—tests of sensory discrimination for lines and weights; tests of controlled and uncontrolled association; tests of memory, in the form of immediate reproduction, recurring fairly systematically at intervals of two or three years; tests of observation, in the form of describing pictures, also recurring at three separate stages. Tests of motor co-ordination are but scantily represented. In the higher years, there are tests of a linguistic and logical character—defining concrete and abstract words, giving differences between pairs of concrete and abstract words, re-arranging words to form a sentence, filling in the words missing from a mutilated text. There are even tests that approach the moral and æsthetic side—a test of the power to resist suggestion, a test of the power to compare ugly and beautiful faces, questions as to what should be done in emergencies both practical and ethical, "What would you do when your house is on fire?" or "when you have broken something that is not yours?"

It is clear that the tests were picked for their practicability; not upon any prearranged plan. Their connection with the "fundamental organ" of intelligence is left practically undetermined. It yields no systematic scheme running consistently through all the groups of tests allotted to the successive years. Indeed, the formulation of such a system would have

¹ See especially *L'Année Psychologique*, 1909, "L'Intelligence des Imbeciles," p. 145.

been premature. "Those who take up the work will find better tests; we are far from pretending that ours are the best." Experience has shown that some tests are, in fact, much better than others. Their value has proved to be amazingly unequal. Mechanical processes, like reciting the days of the months, naming the date, or counting coins—these show very little positive relation to intelligence. On the other hand, the definition of terms and the interpretation of pictures, especially with an improved set of terms and pictures, prove extremely fertile and suggestive. For the rest, scarcely any comparative work has yet been done, either by Binet or his successors, upon the psychological significance or the diagnostic value of the several tests. We need, first of all, careful introspections to determine precisely what conscious process it is that each test evokes. The child has to juxtapose two triangles to make an oblong, to guess a pattern formed by cutting a sheet first folded into four, to detect the features missing from the drawing of a face, to count backwards rapidly: how far do all these depend simply upon the specific capacity of visualization? Again, we need careful comparisons between the child's response to simple interrogation and previous observation of the child's behaviour under the multiple stimuli and confusing motives of everyday life. Is the child who can best describe what he would do if his house was on fire the child who would act most intelligently in the event? Curiously enough, one of Binet's own test-problems is "why should you judge a person by what he does rather than by what he says?" Accordingly, would it not be better to keep the child doing things instead of saying things? For answering questions little else is required besides a ready tongue. Again, if a child does not answer within the allotted number of seconds, how far is this due to lack of intelligence, how far to shyness and timidity, how far to a deliberate intention to be sure, though slow? We need, therefore, a hierarchy of correlations showing how far the various conscious processes evoked and various aspects of behaviour tested are related to one another, and, consequently, to the underlying general intelligence that is postulated. This has never systematically been done.

Nevertheless, those who have employed the method of correlation with other experimental tests have already done much to verify Binet's hypotheses and to clarify his suggestions. The most recent work makes in favour of what Professor de Sanctis has recently termed the theory of two factors. To Professor Spearman we owe a series of brilliant demonstrations of the existence of central factor, commonly termed, general ability.¹ But he himself has insisted that every intellectual performance depends also upon a second group of constituents, namely, specific factors. Their independence is most clearly observed in cases where children, otherwise highly intelligent, are almost unable to read, to calculate, or to visualize. In multiple correlation we possess an instrument for analysing still further the nature of these general and specific mental capacities, and for indicating the kinds of tests which are most closely connected with each. Hunting for intelligence tests before intelligence as such has been isolated or analysed is like seeking an antitoxine for an obscure fever before the bacillus has been discovered. Once the analysis has been made the selection of tests will follow.

(2) The next problem is whether general ability or intelligence is inborn; and, if so, whether the methods proposed test this inborn quality rather than knowledge that is learnt or skill that is acquired.

Professor Karl Pearson and others have found that the degree of resemblance between parent and offspring or between brothers and sisters is much the same for intelligence, estimated by teachers' impressions, as it is for other mental and physical characteristics; the co-efficient of correlation is, as a rule, approximately .5. Subsequent experimental investigations have also indicated that general ability, estimated by intelligence tests, is largely hereditary and, therefore, innate. The evidence for the innate character of defects of intelligence is even more convincing.

It is native intelligence and inborn defect that the Binet scale claims to test. It deals, we are told, with "*intelligence*

¹ cf. Spearman and Hart. "General Ability, Its Existence in Nature." *British Journal of Psychology*, Vol. V., 1912, p. 53. Spearman, "The Theory of the Factors," *The Psychological Review*, Vol. XXI., No. 2, March, 1914.

pure et simple " distinct from "*degré d'instruction*," or "*degré de culture*," in a word, with "*intelligence naturel*." Yet, curiously enough, Binet classifies the various forms of defective intelligence upon the basis of capacities which are largely acquired. Idiots are those who possess no use of language: imbeciles use language in its spoken form, but do not possess the more complex means of social communication, reading or writing; the feeble-minded or debiles possess both. Speech doubtless rests in part upon a hereditary tendency to articulate; and inability to read or to write has been supposed, in some cases, to be due to a congenital defect of specific areas of the brain. But the use, and especially the efficient use, of language is, in all its forms, an art which has to be acquired. In deference to criticisms upon these lines, Binet, in his latest revision, dropped the two tests of reading and the two tests of writing, which his classification had originally induced him to insert. But the entire scale is still left with a marked linguistic bias. Out of fifty-four tests, forty-three, that is about four-fifths, are verbal. Now it may be plausibly maintained that success in rapidly understanding and rapidly and logically answering questions depends, primarily, upon home and school training; and only in an indirect and negative fashion upon innate intelligence. It is from this very point of view that Binet himself criticises the methods in vogue among physicians and psychiatrists. They, very largely, are accustomed to determine the mental level of their patients in the course of an apparently ordinary conversation. Lists of questions suitable for such interviews have often been published in the form of topical questionnaires. Binet prints one such list, and acknowledges his indebtedness to another. They have obviously influenced him to a considerable extent. Yet he criticises them severely. "The method (he says) is at the bottom nothing but an educational examination, a fresh certificate of studies, having as its chief advantage the fact that the questions are fixed in advance, instead of being dependent upon the bad temper or bad digestion of the examiner Hence there is no room for astonishment if from this medley of questions we derive no notion of the gradation of intelligence."¹

¹ *L'Année Psychologique*, 1905, p. 190.

Special, as well as general, training may affect the results. Both linguistic and non-linguistic tests are alike extremely teachable. Arranging weights, making phrases, detecting omissions in pictures, noticing self-contradictions in sentences, juxtaposing two triangles to make a rectangle, defining prescribed objects, answering prescribed questions—these are all simple puzzles and tricks whose teaching is coming to be part of the regular stock-in-trade of the up-to-date teacher. They are tests, too, which can easily be described by children to each other. This teachability would not be serious if it merely resulted in a slight and measurable improvement in an internally graded test; but with externally graded tests, each allowing but two possibilities, namely, failure or success, familiarity may be the decisive factor. A repeated examination with the same tests by the same or different persons, a procedure which is so common and so necessary, is vitiated to an unknown degree by previous practice. No doubt, whatever tests are eventually selected must inevitably be influenced in some degree by acquired dexterity or repeated training: but, if so, the only scientific procedure is to measure the degree of the influence and, according to its amount, either discard the test or allow for practice. This can only be done by a statistical method, like correlation.¹

(3) We now come to the most essential part of Binet's scheme—the relation of intelligence to age. Let us consider first his attempt to determine the general course of mental development in the average child. It is one of the most important achievements of Binet's work to have drawn attention to the importance of the notion of intellectual development. But it was only towards the end of his investigations that he realized how complex a thing this concept was. In an important passage in one of the later articles he distinguishes between what he terms "maturity" of intelligence and "rectitude" of intelligence.² It is in rectitude of intelligence quite as much as in maturity of intelligence that defectives are especially lacking. Maturity is measured by the number and difficulty of the tests successfully passed. But the tests have been devised so as to

¹ This has been done for a few internally graded tests by Dr. Whitley, *An Empirical Study of Certain Tests for Individual Differences*. N.Y. 1911.

² *L'Année Psychologique*, 1908, p. 80.

elicit not only failures but also absurdities. The number of absurdities committed yield a rough index of the rectitude of intelligence. Defectives, according to Binet, commit on an average at least three absurdities; normals, hardly 0.5. We have here an important indication of the limitations of the significance of intellectual development. Having distinguished rectitude and maturity, he goes on to distinguish within maturity, on the one hand, the natural growth or augmentation of the faculty of understanding or judgment, and on the other hand (this is secondary and may be absent) the adventitious increase in knowledge, skill, and experience artificially acquired. We may carry the analysis still further. Natural growth may itself include two processes: first, new functions ripen spontaneously and suddenly emerge at definite epochs; walking, talking, sexual activities, and doubtless other quasi-instinctive processes seem to have almost as definite a period for their eruption as the second teeth. Secondly, old functions seem to pass through a cycle of different phases corresponding to different ages: fear, for instance, may be excited at one period by noises, at another by animals, at yet others by human beings of threatening aspect, by strange situations, by the supernatural, by disease, or by social and moral crises; observation may be directed first to objects and persons, later to their actions, later still to their temporal and spatial relations; and last of all to their attributes and qualities. Acquirements may be similarly analysed. There are those acquired at no fixed date by training at home, those acquired at relatively fixed periods by training at school, those acquired as a result of the child's own attention and retentiveness. These are very unequal in their diagnostic value.

It is clear then, that intellectual development is not quite the simple concept that most investigators have assumed. For Binet, at any rate it is, "un tout bien plus complexe." But, it may be urged, does not our simple central factor provide a simple central line of development? This question involves issues as yet uninvestigated. It is quite conceivable that inborn mental ability is given once and for all at birth; and does not develop, or change in any way except with changes of health.¹ At any

¹ James, for instance (*Principles of Psychology*, Vol. I., p. 663-4), held such a view as regards native retentiveness or memory.

rate, experimental investigations show that, when measured in relative independence of acquired capacity, elementary intellectual functions show very small changes from year to year. Thus, in a test of the reproduction of logical opposites, the increase in ability from year to year is extremely small when compared with the variability of various individuals of the same year. The average annual increment from age 7 to age 18 is only +16'0, starting from 35'0; but the average probable error¹ for a single year is +27'0. So with other tests. The difference between the average for one age-group and the average for the group a year older is almost swamped by the wide differences between the individuals composing that group. Yet the Binet scheme assumes the possibility of measuring stages of development accurately to one-fifth of a year. This implies a grave underestimation of the amount of overlap that is now known to obtain between the various years.

But it still remains possible that, in the average, the small annual increments in most years may obscure a single large increment in one particular year. Thus, the memory-span for figures, which at the age of four is 3, may advance suddenly to 5 at the age of eight, and, with an equal suddenness, to 7 at the age of fifteen. Hence, different tests would appear at different periods: tests of motor co-ordination at one period, tests of sensory discrimination at another, tests of the elements of reading, writing, and arithmetic at another, tests of reasoning and abstraction at yet another, according to the nature of the sudden advance made at each age. This is what the scheme actually shows. The assumption involved appears to be twofold: during any given period a development in some particular capacity may be taken to imply a development in intelligence generally; but a development in general intelligence does not necessarily imply a development in all the particular capacities at once, or in the same particular capacity at all periods. If, however, this be so, clearly the only thorough procedure will be, first, to measure the

¹ The "probable error" marks the limits above and below the average, within which one-half of the group will be found. Thus, the average and probable error for 13 year old children in the test mentioned are 115'2 and 43'5; *i.e.*, the central half of the group alone covers a range extending from 71'7 to 158'7. This is a greater range than that covered by the entire period of six years measured.

same capacities at every age throughout and discover precisely at what year, if any, their sudden augmentation falls; and, secondly, to determine the degree of correlation between the development of the several capacities measured and general intelligence as a whole. In any case, to assign a child a single flat mental age as though all his powers grew, and must grow, steadily side by side cannot but be misleading. And if, further, as we have reason to suppose, the period of quickest growth in a given capacity is not the same for all individuals, if for instance, the many London schoolboys develop the power to resist certain suggestions long before they can define certain abstract terms, while others, like Binet's subjects, apparently develop both powers in the same year—then the entire question is incredibly complex.

The differences in development shown by the two sexes, and the inadequate provision made for testing the developments during the period of puberty and adolescence (quite the most critical developmental period of all), are more familiar topics of criticism, upon which I have no room to enlarge.

In spite of all these criticisms, it is, I am convinced, in the vivid preliminary picture given of the general course of the average child's mental development that the most valuable part of Binet's scheme consists.

The point, however, which has attracted the greatest commendation has been the endeavour to express individual differences, and especially subnormal differences, in terms of the average development of the normal child. Intelligence, he suggests, may be measured in terms of mental years; and the scheme which serves to measure the differences between the same mind at different ages may also serve to measure the differences between different minds, irrespective of their age. Curious as it may appear, while the details of the scheme have constantly been criticised, this, the central feature of the whole proposal has scarcely ever been questioned. It is to this point that I would direct especial attention.

To begin with, we must admit that for many practical purposes, where not a technical but rather a popular estimate of intelligence is required, the conception of a mental age will

always be found useful. It must further be admitted that the analogies between states of defect and states of immaturity, which so constantly struck Binet, are points of the utmost interest. Yet, I believe, the similarity was, at first, overestimated. "So numerous and so curious are the resemblances (he writes) that on reading the responses of a child whose age was not given, one could not tell whether it were normal or abnormal."¹ In his later work, however, he himself showed that defective child would commit absurdities which a normal child, however young, would rarely make.

Let us now consider the assumptions upon which his principle of measurement is based.

It assumes, in the first place, that all differences in intelligence may be regarded as falling within a single dimension and lying along a single scale. Crudely put, it means, so far as normal intelligence is concerned, that the essential differences between Smith, Brown, Jones and the rest of mankind may be regarded as points in the same straight line through which the greatest of them all, Shakespere, let us suppose, passed successively in the course of his mental evolution. As regards abnormal personalities, it means, as Binet avows, that all forms of mental defect, except instability (by which he seems to mean emotional and moral defect) are cases of arrested or retarded general development. Both implications are untenable. Indeed, the failure of Binet's successors to realize the extreme heterogeneity of the class known as mental defectives or "anormaux" is amazing. We have seen that Binet himself came somewhat hesitatingly to separate abnormalities in the "rectitude" of intelligence from deficiencies in its "maturity"; and that he apparently regarded the normal maturation of intelligence as involving sudden changes in kind rather than gradual changes in degree. Later, he recognised an important modification of intelligence or "judgment," which he terms "*esprit faux*." Here the several faculties are developed or retarded disproportionately. Consequently, the condition "does not correspond to any regular stage of psychological evolution."

¹ *L'Année Psychologique*, 1905, p. 320-1.

Secondly, his principle assumes that the annual increments of intelligence may be treated as equal in amount; in other words, that the curve of intellectual development is best represented by an inclined straight line. How far is this true? It is commonly supposed that mental development runs parallel to physical growth; and that this in turn may be fairly estimated by the average heights and weights of children of different ages. During school life, the general changes in weight, and more especially in height, may be roughly represented by straight lines. This, however, obscures two well-known facts. First, growth does not go on for ever. If we regard the course of growth as a whole, the curve becomes logarithmic in character; height and weight increase, but the rate of increase declines. Secondly, the rate fluctuates periodically before it finally falls. Growth is spasmodic; the curve representing it is not a simple arch; it undulates as it rises. At the ages of about six, nine and fourteen the annual increment in height may rise to nearly $2\frac{1}{2}$ or 3 inches; at about eight and again at about twelve it may sink to hardly more than half that amount.¹ To say that from five to fourteen children grow on an average 2 inches every year is to obscure this familiar fact. In explanation, it is commonly stated that in growth periods of advance alternate with periods of adjustment. If this is true of physical life, it is far more likely to be true of mental life.

Apart from the supposed rough parallelism between physical and mental development, little is known about the relation of mental capacities to age. Previous to Binet's work, the functions studied had been for the most part simple processes like sensory discrimination and rapidity of reaction. Memory is perhaps the capacity whose development has been most frequently investigated. On the whole, the various forms of memory tend to improve in early years with age. There are, however, periods of rapid development followed by periods showing no improvement or even retrogression. As a rule, the greatest improvements occur between the ages of 10 and 12; after this development is retarded and there are symptoms

¹ For recent figures cf. *Annual Report for 1912 by the Chief Medical Officer of the Board of Education*, pp. 399-407.

of absolute decline. Considered specifically, the various forms of memory develop at different rates, and at periods that do not coincide either in the two sexes or in different social classes. It would be quite futile to attempt to measure differences in memory in terms of a memory age. What has been found in the case of memory probably holds true of other mental capacities. Before and after entering school, before and during adolescence, a year's growth in intelligence means very different things. The course of mental development is thus by no means a simple steady rise.

Except for rough and popular purposes, then, Binet's intention of measuring native intelligence in terms of mental years seems impracticable. It is like measuring stature with an elastic rod, warped in two or three places along its length, and telescoped in upon itself at the upper end.

(To be continued in the next number.)